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Unpacking the Formation of Favourable Environments for Urban Experimentation: The Case of the Bristol Energy Scene

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Abstract: Urban experimentation with sustainability has been gaining prominence in policy and academic discourses about urban transformations, spurring the creation of urban living laboratories and transition arenas. However, the academic literature has only begun examining why experimentation flourishes in particular cities, and why it conforms to place-specific styles. Meanwhile, the strategic niche management (SNM) tradition has extensively explored how protective spaces for experimentation emerge but has dealt only tangentially with why this happens in particular places. In this paper, we develop an approach for unpacking the formation of favourable environments for experimentation in specific places. We adopt an abductive research design to create a dialogue between distinct theoretical positions and one in-depth case study. Our case examines the formation of the Bristol energy scene, which hosts a variety of experimental initiatives concerning civic energy alternatives. Based on our findings, we refine the understanding of the processes shaping this experimental setting. There is value in characterising the 'genealogy' of experimental spaces and acknowledging their antecedents, path-dependencies and place-specificities. Efforts to foster urban transformation demand nuanced accounts of how places become experimental because they are not static backgrounds for experimentation.

Keywords: urban experimentation; strategic niche management; urban energy transitions; Bristol; sustainability transitions

1. Introduction

Urban experimentation with sustainability has been gaining traction in academic and policy discourses as a way to enable transitions towards more sustainable futures [1–3]. Urban experiments are being mobilised not merely to study the city but also to probe diverse urban futures, harness innovations to transform the city and its various sociotechnical systems [4–6] and contribute to developing the capacities required for transformation [7]. Proponents of urban experimentation have devised and implemented a variety of experimental spaces, such as urban living laboratories, transition arenas, platforms, and experimental districts, which are the object of a thriving body of literature [8–12]. While the literature on urban experimentation has emphasised deliberate efforts to construct experimental spaces, the question of how a particular place or city becomes a favourable environment for experimentation with sustainability has hardly been asked. This is the question we explore here.

Scholars in the sustainability transitions field [13] have dealt tangentially with the history of experimentation in particular places. Most analyses focus on systemic change at national or international scales, foregrounding emerging technologies while place-specific factors reside in the background. This is also the case for the strategic niche management (SNM) strand of this literature.

However, this strand contains insights that are relevant to our question due to its emphasis on niches—spaces that afford temporary protection for experimentation and learning that nourishes path-breaking innovations [14,15]. Studies have detailed the processes and politics involved in the emergence and deliberate development of such niches [16–18] and highlighted that local experiments co-evolve with niches that comprise multiple localities [16,19–21]. We take SNM as a starting point to develop a perspective that puts places, rather than socio-technical systems, up front.

Vibrant debates surround the niche concept, but it remains unclear how to operationalise these insights into a place-based approach. There has been much attention to the geography of sustainability transitions [22–24], the characteristics of sustainability experiments [25,26], and the politics of urban transitions [27–29]. These studies identify limitations in the current conceptualisation of niche formation and caution against assuming that cities are equivalent to niches. More recently, this literature has begun asking questions concerning how places can be reconfigured by multiple kinds of local experiments [4,6,22], why experiments proliferate and flourish in certain places [23,30–32], and how situated institutional arrangements shape place-specific styles of experimentation [33,34]. A place-based perspective would enable research in these areas.

Drawing on these debates, we put forward an approach to understand the emergence of favourable environments for experimentation in a particular city. We argue that it is complementary to existing accounts of niche formation precisely because it shifts attention away from the design and development of niches, towards a focus on the development of a broader place-based environment for urban experimentation. We explore and develop this focus with a case study of Bristol.

If the UK's energy sector had a laboratory for civic alternatives, Bristol would likely be its home. It hosts an exceptional concentration of experiments and policy initiatives signalling a low-carbon energy transition. Grassroots organisations, the local government, skilled intermediaries, and social entrepreneurs are all implicated, in what could be described as an emerging 'energy scene'. This includes the UK's largest energy cooperative, a new municipal energy company (Bristol Energy), and a myriad of experiments which are broadly oriented around civic goals such as local empowerment, local economic development and sustainability. This level of engagement is atypical in its diversity and persistence, which previous studies attributed to a green and alternative milieu: a localised concentration of green, countercultural movements which sustain a distinctive cultural environment and political orientation with origins in the 1970s [35–38]. These characteristics seem to be reinforced by the local authorities' recent impetus to position the city as an exemplar in matters of sustainability and as a 'laboratory for change' [39].

The outline of the paper is as follows. In Section 2, we review the current literature; our aim is not to produce an exhaustive literature review but to distil crucial insights to address our question. We review the prevalent representation of how niches are formed and identify the main limitations for its application in the study of places and urban contexts (Section 2.1). We address these issues by adapting elements of the 'contextual reconfiguration' perspective [4], to understand how experiments, social interests, and ways of governing are assembled to reshape a particular urban context. We develop our place-based approach in Section 2.2 and present our methodology in Section 3. We then recount the emergence of the Bristol energy scene (Section 4) and discuss the results of our case study (Section 5). To conclude, we consider the implications of our study for current theories of niche formation and urban sustainability transitions research (Section 6).

2. Reconceptualising How Places Become Favourable Environments for Experimentation

The sustainability transitions field and, in particular, the SNM strand [14–16,18,19] deals extensively with how niches are formed, but only implicitly with how this unfolds spatially. Building on a quasi-evolutionary view of sociotechnical change, this body of work highlights the mechanisms of variation, selection and retention which modulate which ideas, concepts and designs attain widespread purchase. Its core focus is, however, on understanding selection. Experimentation with alternative technologies and practices is perceived as a desirable strategy to increase the chances

that variations may become selected. This is salient in the case of sustainability because most radical variations (innovations) for sustainability tend to be suppressed by the selective pressures exerted by an entrenched set of rules which form the sociotechnical regime [40]. Incremental innovations tend to be retained while radical innovations often perish without the necessary support. From a quasi-evolutionary perspective, we thus focus on the question of how and why variation is more intense in certain places.

Pioneering work proposed that radical variations for sustainability happen because of the existence of niches and suggested they could be created through deliberate experimentation [14,15,41]. These spaces were theorised as alternative selective environments with rules, conditions and resources that are distinct from those encountered in the mainstream selection environment. These conditions enable actors embedded in these spaces (niche actors) to experiment and learn about novel technologies, practices and conceptions. By managing the development of niches, governments and other social groups could promote regime shifts towards sustainability. As many historical case studies demonstrate, this process is never automatic or deterministic; whether transitions happen depends on the confluence of many developments which cannot be predicted, and involved conflict between niche and regime actors, as conceptualised in the Multi-Level Perspective (MLP) [42–44].

Initially, scholars focused on niche-internal processes, aiming to identify strategies for managing niches and enact transitions. According to their findings, niches can be developed by strategically initiating experiments—'planned initiatives that embody a highly novel socio-technical configuration likely to lead to substantial (environmental) sustainability gains' [45] (see also [25] for a recent review of the concept).

This early empirical work dealt with how the social, cultural, material and institutional structures within cities or regions influence the development of protective spaces but did so using the analytical categories of the MLP which were not explicitly geographical.

As human geographers have recently shown, this meant that the places where experiments 'take place' have been treated primarily as a location or site where aspects of socio-technical systems are located [46,47]. Thus, the analytical tools downplayed two other dimensions which are crucial for understanding places: locale, or place as the concrete and historically contingent settings in which social interaction occurs (sometimes referred to as situation), and sense of place, which refers to the affective or subjective orientation that ensues from living in a place [48,49]. As Murphy argues [47] (p. 83), attending to these dimensions matters because

> Meanings, identities, histories, and situations shape the political dynamics of planning and policy making, provide senses of unity or division within communities, and/or serve to stimulate the rise of social movements that seek to improve socioeconomic conditions, address environmental problems, and/or advance ideological agendas.

Ignoring these dimensions leads to a degree of indifference about where niches develop, and transitions unfold [50], and to the implicit assumption that niches can be constructed anywhere if the right processes are in place.

2.1. Local–Global Model and Its Limitations

This partial understanding of place can also be found in the local–global model, which further conceptualised the relationships between experimentation, niche formation, and prospective transitions (Figure 1) [16,19]. This model depicts niche formation as emerging from aggregation and learning through a sequence of experiments which may be dispersed geographically. Initially, a proliferation of experiments emerges, informed by the inadequacies of the existing sociotechnical regime, the pressures from a macro-context (landscape), and the local conditions in multiple localities, generating variety. For the emergence of experiments to take place, the shielding of niches is necessary: these are processes modulating the pressures exerted by the dominant regime [16]. The theory distinguishes two forms of shielding: passive shielding when niche-actors benefit from pre-existing geographical, institutional and

cultural features; active shielding when actors deliberately and strategically seek to create protective spaces [16]. This also allows analysts to distinguish passive and active protective spaces.

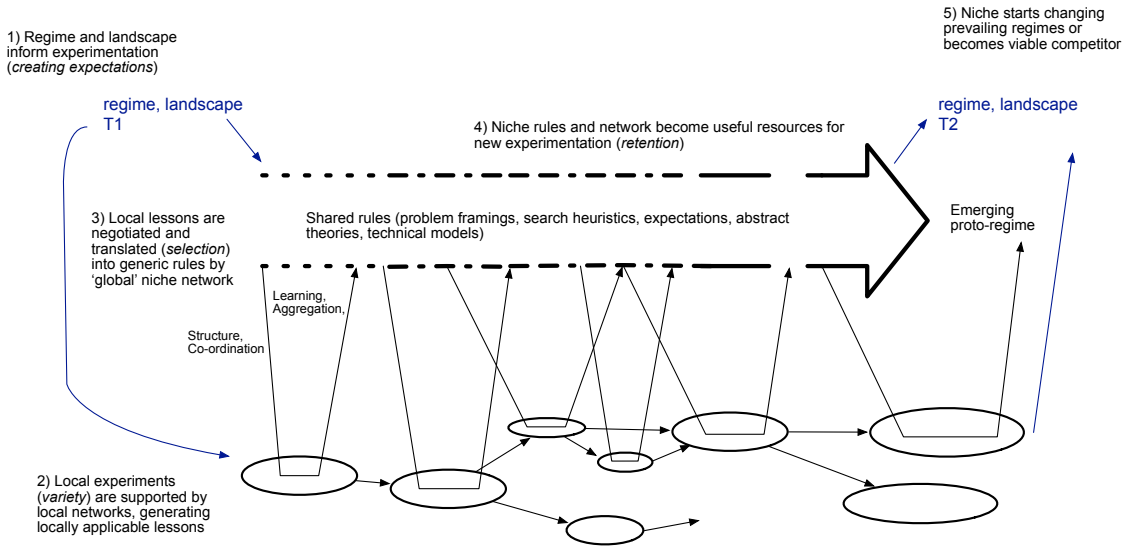


Figure 1. Local–global model for niche development, reprinted from [16], adapted from [19]. Reprinted from [16], with permission from Elsevier. Permission regarding [19] was also granted by Taylor and Francis (www.tandfonline.com).

Protective spaces can also nurture path-breaking innovations through (i) assisting learning; (ii) the strengthening of social networks; and (iii) articulating expectations [18]. Intermediary actors play an important role in the nurturing process. In particular, they are crucially important for aggregating and translating the lessons generated in experiments (Figure 1). Gradually, the accumulation of local lessons may lead to the emergence of a set of shared rules and routines, in a global or trans-local institutional field, that further protects experiments from the selective pressures of the dominant regime [16]. For example, International consultancies, conferences, and standard-setting organisations connect local processes, share best practices, and establish standards, thus helping to structure (through framing and coordination) local activities [51]. As shared rules consolidate at this global level, and the niche continues to expand, further experimentation tends to be framed by reinterpretations and reinventions of a generic emerging technological trajectory [52]. This may give rise to a proto-regime—a working socio-technical configuration with the potential to compete and challenge the existing regime—and ultimately provoke a regime shift to sustainability under the right conditions [15,53].

Much of the SNM literature is concerned with how a sequence of experiments in different localities contribute towards the development of non-situated niches—also referred to as global niches—that may bring about transitions of sociotechnical systems (e.g., energy system, water system). This perspective emphasises the process of developing shared lessons and sees the building of shared vision and expectations around a particular sociotechnical trajectory as necessary for niche development. Intermediaries carry out the articulation of expectations, which supposedly mitigates some of the potential conflicts about alternative visions for future developments. Studies tend to trace niches in their journey towards becoming a proto-regime, foregrounding promising experiments with technologies such as solar PV, wind turbines, and fuel cells, and the actors directly implicated in developing them (including engineers, designers, and users).

Recently, spatially explicit reconceptualisations of this model were proposed [20,21] but were also targeted at transnational niches. Beyond an initial focus on radical technological innovation in energy, mobility, food, and other societal systems organised primarily at a national scale, SNM-inspired conceptualisations figure in debates about urban experimentation [1,2] and grassroots innovations [31,54,55]. Nevertheless, the local–global model and its spatialised versions remain most

suited for studying the aggregation of similar or complementary experiments occurring in multiple localities, but which challenge a single sociotechnical system. There has been little attention to how particular places evolve as favourable environments for experimentation with sustainability.

It is tempting to address this question using the local–global model, assuming that a place becomes a favourable environment through the gradual build-up of experiments situated there. The recent geographical turn in sustainability transitions literatures [22,23,46], however, levies three important limitations to such an approach.

First, various studies highlight the *multiplicity of urban experimentation*. Assuming that experiments accumulate gradually to form a distinctive trajectory risks neglecting the contested, 'multi-interest', and political nature of the urban context [56]. Urban forms of experimentation are not framed by singular socio-technical trajectories [22]. Instead of assuming an undisputed set of shared rules as the outcomes of experimentation, we should address how distinct framings and visions are made, mobilised and contested [47,57,58]. Local stakeholders often experiment with multiple socio-technological pathways and have to negotiate a variety of interests and visions [6,57,59]. Urban experiments are initiated by a variety of actors, often overlap, compete for resources and open up opportunities for political action, and thus do not conform to assumptions implicit in SNM' approaches [3]. Instead, experiments may act as a critical site for urban climate politics, which 'could provide grist in the urban mill, creating conflict, sparking controversy' [3]. In this view, the 'aggregation of learning occurs not only in a global niche community, but also in the multi-interest context of local politics' [56]. These insights led us to reconsider the assumption that a sequence of experimentation informed by a particular trajectory is responsible for the formation of a protective space and focus more on the contestation around differing visions for urban transitions.

Second, *place-specificity* needs to be considered because experiments reflect the character of a place in which they are situated, and in turn, may help reinforce that character. Protective spaces and the kinds of experiments they harbour are contingent on place-dependant factors [23] such as formal and informal institutional configurations [60]; the buzz of intense face-to-face interactions, inter-organisational relations and the clustering of organisations [20,61]; the vibrancy of local grassroots organisations [31,45]; and the geographical proximity to natural resources endowments [62]. These factors matter in explaining why certain places are more likely to spur experimentation, but also in understanding the style of experimentation prevalent in a place [33,34]. Our approach builds on these richer accounts of how place-dependant factors enable the actors embedded in these places and is attentive to the three-dimensional understanding of place outlined by Agnew [48,49] to characterise what patterns of experimentation arise due to these factors.

Third, the analysis should attend to the '*co-existence and interdependence of local and non-local relationships*' [23]. Conflating niches with the local scale obscures processes of social change that sustain or threaten protective spaces, but which are not captured by describing local–global iterations or niche-regime interactions. These encompass (un)stable multi-level institutional arrangements that shape the capacities of sub-national authorities to support experiments, and which can result in path-dependent styles of experimentation [33,63], crises or windows of opportunity that spur experimentation [58], and discursive shifts repositioning cities as crucial spaces for redressing climate change [64]. These observations suggest we should consider multi-scalar relationships and interrogate the stable and unstable periods of formation of a favourable environment for experimentation.

2.2. Elements of a Place-Based Approach

To address these limitations and understand how a favourable environment for experimentation emerges in an urban context, in the long run, we argue that a place-based approach is necessary. Rather than focusing only on promising experiments feeding into niches that emerge and grow at a trans-local level, we now explore the building blocks for an approach that takes on the standpoint of a place while building on the insights from the local–global model.

2.2.1. Contextual Reconfiguration

To address the issue of multiplicity, we draw on a broader understanding of urban experimentation recently proposed by Hodson et al. [4]. They focus on how a particular place is reconfigured through a wider set of urban experimental processes 'of assembling technologies, social interests, and new modes of governing into place-based configurations and learning about these processes of embedding an infrastructure or a scheme in a particular place' (p. 6). Conceptualising urban transitions as processes of contextual reconfiguration, they propose to unpack the (p. 13) competing, coexisting and complementary interactions between multiple experimental processes which generate new place-based configurations. Although the focus on reconfiguration is useful (see the comparison in Table 1), this approach is not explicit about how a given context becomes favourable for experimentation. To handle this task, we need to integrate three more concepts already present in the literature, namely settlement, modes of governing and patterns of experimentation.

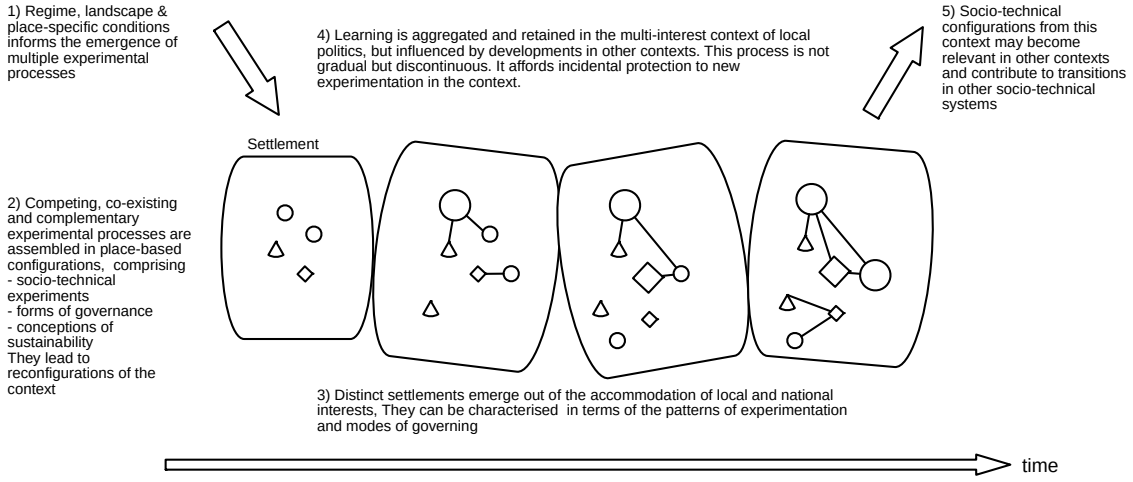


Figure 2. Place-based approach for analysing the evolution of favourable environments for experimentation, adapted from the local–global model and contextual configuration.

Table 1. Contrasting assumptions and analytical dimensions of the different approaches.

Analytical Dimensions	Local–Global Model	Contextual Reconfiguration	Our Approach
Assumption about emergence of a favourable environment for experimentation	Niche formation as the outcome of intentional efforts to develop niches and gradual accumulation of lessons from experiments in a trans-local level, which support further experimentation (Figure 1).	Not directly applicable	Formation of a place-based niche formation as the outcome of a process of contextual reconfiguration, driven by interactions between multiple urban experimental processes embedded in a place. This process is affected by multi-scalar relationships and open to contestation and is potentially discontinuous. Over time, viable place-based configurations may emerge, reconfiguring the urban context and its systems (see Figure 2)
Assumption about the interplay between experimentation and urban transition	Not directly applicable	Multiple urban experimental processes embedded in a place being assembled into place-based configurations, reconfiguring the urban context and its systems	
Experimentation	How aggregation and learning from multiple experiments contribute to developing a niche?	How multiple urban experimental processes interact within a city?	What patterns of experimentation emerge and how do they contribute to developing a favourable environment for experimentation?
Intermediation/Governance	How do intermediaries and niche actors develop the niche?	How interactions between different modes of governing influence urban experimental processes?	How interactions between different modes of governing influence urban experimental processes?
Expectations/understandings of sustainability	How are expectations of different actors aligned?	What understandings of sustainability prevail in shaping experimental processes and who promotes them?	During different settlements, what understandings of sustainability and interests prevail in shaping experimental processes and who promotes them?

2.2.2. Settlements

The concept of settlements helps to address the multi-scalar relationships and contested nature of urban experimentation. In studies of local politics, Ward [65] conceives settlements as periods demarcated by the existence of stable institutional or governance arrangements that emerge from the accommodation of interests at the intersection between national level politics and local concerns (e.g., the intersection between the development of a neoliberal state and local regeneration policies). This also resonates with Raven et al.'s study of how situated institutional arrangements [33], which result from the interplay of inter-scalar processes and relationships, inform and are reproduced through particular styles of experimentation. When a settlement emerges, framings promoted by powerful actors may dominate public discussion, leading to recognisable patterns of intervention by local authorities. Similarly, settlements figure in theorisations of 'strategic action fields' that are fruitful in the study of grassroots activism [58]. Here, actors are seen as embedded in 'socially constructed arenas within which actors with varying resource endowments vie for advantage' [66]. Mutual dependence between actors means that episodic contention or instability due to external shocks can give way to settlements, re-establishing collaboration, orderliness, with a dominant frame of what is at stake [66].

Drawing from these perspectives, we conceive settlements as the periods with stable constellations of actors and prevailing framings of what is at stake, resulting in particular patterns of activity (different patterns of experimentation, in our case) and modes of governing this activity. Settlements emerge from temporary standoffs between actors, which result from contestation and cooperation and exposure to external pressures. This concept, combined with the notion of contextual reconfiguration, can support accounts of the long-term evolution of a given place (Figure 2). Here, instead of assuming that experiments are part of a long sequence which contribute inexorably towards developing a socio-technical trajectory, the history of how a place comes to be configured as a favourable environment for experimentation can be analysed as a sequence of settlements.

2.2.3. Modes of Governing

To characterise the prevailing interactions between different forms of urban governance within a settlement, we draw from an established typology of modes of governing. Based on a study of municipal climate action in the UK and Germany, Bulkeley and Kern [67] delineate four distinctive but overlapping modes of governing climate change in cities: *self-governing*, comprising activities whereby the local government manages its own activities; *governing by provision*, comprising the delivery of particular forms of service and resource to shape new practices; *governing by authority*, the use of traditional forms of authority such as regulation and direction which persist despite reforms; *governing through enabling*: 'facilitating, co-ordinating and encouraging action through partnership with private- and voluntary-sector agencies, and to various forms of community engagement'.

Other studies demonstrated that in different periods municipal authorities are capable of mobilising specific modes of governing. Bulkeley and Betsill [68], for example, identify that in the early 1990s, local authorities in Europe were largely reliant on voluntary self-governing measures, for which they denoted an era of 'municipal voluntarism'. Around the 2000s, with the mainstreaming of climate change, municipal authorities sought to expand their capacities to deal with climate change and integrate it into other imperatives such as economic development and intercity competition, with the enabling mode of governing gained prominence in an era of 'strategic urbanism'. There is evidence that a new era of governing by experimentation is emerging, with actors explicitly framing their interventions in experimental terms or proactively seeking to create urban laboratories as dedicated spaces for experimentation [3,9]. Our study contributes to these discussions by examining an instance of this trend, interrogating how this mode of governing emerges as a viable option in a particular context and unpacking how it relates to other modes of governing.

2.2.4. Patterns of Experimentation

Attentive to observations that particular styles of experimentation tend to be privileged by situated institutional arrangements [33], and calls for richer accounts of how this occurs [22], our approach characterises the *patterns of experimentation* that emerge in different settlements. Existing typologies of experiments fall short of this task because they take individual experiments as a departing point or assume that there is a singular experimental style in a place c.f. [33,34].

Our interest in exploring patterns of experimentation stems from acknowledging the multiplicity of urban experimental processes, which demands attention to who carries out these processes, how they are being framed, and whether they are complementary, competing or co-existing with one another [4]. For example, in a given settlement, do-it-yourself community projects aimed at local empowerment may develop with complementarities with government-led experimental business models for city-wide energy provision aimed at economic development, and in another settlement, the relationships between these initiatives might become competitive. Observing these distinct patterns, instead of conflating them as a single style allows a more nuanced account of the formation of that environment. As we are interested in exploring how these patterns arise, we seek to elicit them from the case study.

In sum, we propose that a place-based niche can be formed through a process of contextual reconfiguration, whereby multiple urban experimental processes embedded in a particular place become assembled into socio-technical configurations that comprise specific technologies, modes of governing and conceptions of sustainability. The temporal evolution of these configurations tends to be discontinuous and jagged, as they are subject to multi-scalar relationships and contestation. To best study these discontinuous and varied processes, we analyse the sequence of different settlements, highlighting the modes of governing and patterns of experimentation that arise. We use this approach to trace the development of a favourable context for experimentation in Bristol.

3. Methodology and Data Sources

Our objectives entail a methodology capable of identifying the salient processes involved in the emergence of a favourable context for experimentation in Bristol and understanding its changing character over a long period. The limitations we identified in the literature demand a processual, relational and nuanced account of this journey that can capture the historically contingent, situated and contested character of places [47]. Thus, we adopted a case-study approach because of its suitability for an in-depth examination of context-specific, multi-actor processes, and the possibility of combining different forms of evidence [69]. In developing our case narrative, we followed an iterative process of matching existing theory and empirical observation and fitting the framework above and the case in Bristol. Our research journey can, a posteriori, be described as an instance of 'systematic combining': 'a nonlinear, path-dependent process of combining efforts with the ultimate objective of matching theory and reality' [70]. In that journey, we benefited from the recent publication on contextual reconfiguration, which addressed some shortcomings of our preliminary framework and offered a better matching with our observations and led to a redirection in the study.

We adopted a process approach to this research. Process approaches are concerned with how and why things evolve and examine events and contextual processes implicated in a particular case. This is congruent with conceptualisations of systemic change that emphasise reconfiguration [71]. The process approach enabled us to focus on the entities that participate in events and assume that the set of entities may change over time (e.g., as new actors come forward). The complexity of these events is captured in a case-narrative. In the process approach, generality depends on the versatility of the patterns and mechanisms identified: it matters whether they explain the processes of wider category [72]. In this study, our approach has to be adaptable to study the how and why favourable environments for experimentation emerge in particular places.

In selecting the case study of Bristol, we were motivated by observing that it comprises levels of grassroots mobilisation and local government engagement, which span various domains of sustainability, are broadly oriented towards civic goals and has been active since the 1970s [35,37,73].

We, therefore, considered that Bristol represents an extreme/deviant case [74] because its diversity, persistency and directionality that are atypical in the UK.

The data collection consisted of desk research of the available academic literature covering developments in Bristol's civil society and governance, complemented with 10 semi-structured interviews (see Appendix A) with stakeholders providing an insiders' perspective into the activities and efforts to structure the Bristol Energy's scene. These interviews were realised during three site visits between July 2015 and August 2016. Thematic and open coding on N-vivo was used to elicit the main events. They were triangulated with archival research in the Bristol Archives, covering the material collected by the Green Roots project [35], official documents appertaining to energy-related activities of the local government; and secondary sources covering key events (newspapers, reports and policy documents).

4. Evolving Context for Civic Energy Experimentation in Bristol

In this section, we recount the evolution in Bristol of a favourable environment for experimentation with civic forms of energy provision. We trace the contextual reconfiguration of the alternative milieu in Bristol through four distinct settlements.

4.1. First Settlement

In this settlement, the proliferation of grassroots activism led to the emergence of an alternative milieu in the city. Bristol's environmental movement can be traced back to the late 1960s and 1970s. In 1966, a modernist plan for the regeneration of the city centre sparked a wave of protests that questioned its social and environmental implications. The protesters were successful in stopping the plan. From its mobilisations, different activist groups began coalescing, including Bristol and Avon Friends of the Earth (BFOE, 1971), Urban Centre for Alternative Technology (UCAT, 1979, now Centre for Sustainable Energy), and Cyclebag (1977, now SUSTRANS). Local environmental activism was emboldened by the nascent global environmental movement which had grown around concerns over pollution, fossil fuel dependence and the risks of nuclear power. They shared a sense of urgency, a distinctive political orientation close to anarchism [75], and the emerging canon of the global environmental movement, of which Schumacher's *Small is Beautiful* was particularly influential. These influences inspired initiatives challenging the reliance on centralised large-scale infrastructures, arguing for more socially and environmentally attentive systems of provision appropriate to local circumstances [35,75]. Many groups in Bristol adopted a 'do-it-yourself' (DIY) ethos that was widespread in the South West of England and Wales [37].

Under these influences, experimentation in this period followed a pattern of small-scale, practical solutions, often involving bricolage with locally available resources [76] although informed by conceptual innovations emerging in other localities. This was pursued in parallel by various groups, which found some complementarities as they began to agglomerate. A significant example was UCAT, which was established to bring alternative technology to the urban context, by activists who had visited and studied at the Centre for Alternative Technology (CAT) in North Wales. Thematically, the centre focused on energy. It operated as a cooperative and grew quickly, attaining 400 members in 1982 [35]. It intended to combine activities in exhibition and information; demonstration; education and social development [77]. One such initiative was the 'Future Home', the first low-energy demonstration house in the UK, which hosted multiple experiments with a holistic perspective on energy autonomy, around which 'were woven many strands of thinking (. . .) food and soils, water, the reuse of old buildings, user-control, satisfying work, access for all, and integration with the wider community' [77]. UCAT was intended as 'catalyst for new beginnings', working closely with other groups in the city to 'nurture (. . .) seed-points of social renewal' [77], and highlighting the 'interrelatedness of apparently disparate movements: e.g., cycling, wholefoods, anthroposophy' (p. 7). Another of its initiatives, the Green Leaf bookshop, became a cornerstone of a cluster of activism that formed in Colston Street, that emerged in the 1980s when a property developer started offering low-cost rentals for

environmental organisations [35]. This place became an early embodiment of the green and alternative milieu in Bristol, increasing its buzz and facilitating the contact between different groups and exchange of ideas and knowledge.

In the energy domain, practical experiments went hand-in-hand with direct action opposing hard energy paths. Environmental groups in Bristol were pre-eminent in mobilisations against the expansion of Nuclear Power in the UK, in part due to the geographical location near Hinckley Point. The South West region had, at that point, four nuclear reactors; nuclear waste carriers crossed the Bristol railway lines [35]. Through their experiments and mobilisation, BFOE and UCAT and other environmental groups developed a combination of tacit and technical knowledge about energy and environmental matters and critical knowledge about the political economy of energy in the UK, becoming a critical voice in National policy debates. They were also grounding these debates in their local context, advocating action by the council and informing the population. In 1990, for example, the BFOE convened a city-wide Energy Group, whose invitation letter remains surprisingly relevant three decades later:

> There is confusion in the Government on Energy issues: nuclear power has shown itself to be very expensive, yet the Government is trying to keep it open as an option. Plans for nuclear waste disposal are non-existent. Renewable energy is becoming accepted to some extent (. . .) but there are few clear national directives on this. Energy Conservation has been demonstrated to be one of the most immediate ways of cutting carbon dioxide emissions, but the government has refused to take any steps to promote conservation (. . .). [78]

In this period, the local government was largely disempowered to tackle emerging environmental issues, only tentatively developing an enabling mode of governing. In the energy domain, it had very little discretion, as a vertically-integrated regional company had been formed in 1948 and privatised in 1990 [79]. Local environmental groups and other volunteering organisations drew support primarily from central government funding. They also sought partnerships with a weakened local authority, but this support was unstable. During the Thatcher Conservative Government (1979–1990), Westminster adopted a directive approach to urban policy [80]. A series of reforms curtailed the local discretion over spending with public services; councils were expected to act as *contracting authorities* [81]. The accompanying neo-liberal reforms positioned volunteering as a desirable substitute for state provision of public services; central government Initiatives such as the Youth Opportunities Programme and Community Programme helped expand the third sector [82]. Funded by these, local groups pursued partnerships with the Bristol City Council (BCC), which also dedicated a large share of its central government funding to supporting local charities. These programmes and partnerships provided groups with core funding, rather than project-based grants. When the financial situation was good, they could staff campaigns and services and expand to address the demand for services such as kerbside waste collection, energy advice and training, and building of cycling routes [35]. For example, Simon Roberts, later director of the Centre for Sustainable Energy (Box 1), was one such volunteer in the building of UCAT's visiting centre. Nevertheless, most groups were mired in 'chronic insecurities generated by frequent switches of programmes and policy emphasis' [82]. Despite its supportive stance, BCC's leadership and organisational capacity were constrained [80,83]. Between 1974 and 1996, a two-tier governance arrangement compounded this situation:

> (. . .) we had a quite weak council, partially because for a long time it was two tiers [with Avon County Council] (. . .) the county council that seemed quite desperate not to be too Bristol centric (. . .) even when it became a unitary authority [1996] it didn't have a tradition of municipalism which you would tend to find in northern cities (. . .) where the expectation is that the public sector will provide, lead and be the locus for action. (interview with Simon Roberts OBE, Director of CSE).

Hence, local environmental groups were growing and forming partnerships with the council but lacked coordination. Despite the agglomeration around Colston Street, and the efforts of

intermediaries such as the Bristol Voluntary Sector Council and Bristol Community Groups Network, the alternative milieu was fragmentary and fiscally dependent [80], resulting in duplication and rivalries between groups.

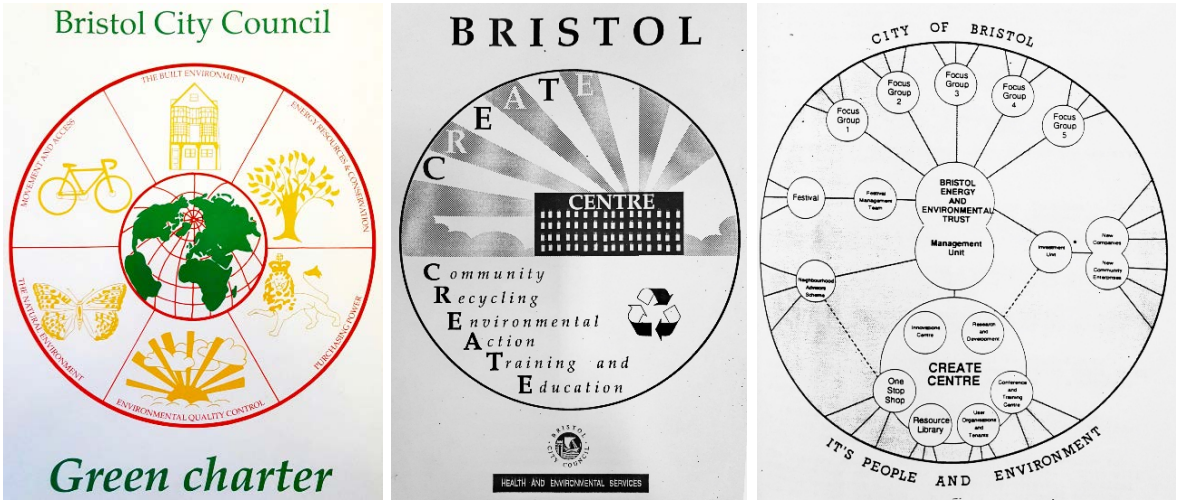
> (Bristol) It's a very interesting place and a very interesting city for grassroots initiatives. There's more here than anywhere else. We usually have not one but at least two of everything (. . .). We are not the only place for anything, and we learn from others, but when we do it there's lots that happens. Sometimes rival, rival projects. (Interview Councillor Martin Fodor)

4.2. Second Settlement

In the late 1980s and early 1990s, the alternative milieu in the city consolidated thanks to the institutionalisation of the sustainable development agenda, the associated attempts by the local authority to support and enable local action, and the growing attractiveness and reputation of the local cluster of environmental organisations. This came in the wake of the Brundtland Commission in 1987, Rio Conference in 1992 and Local Agenda 21 in 1993, which opened space for a more proactive local authority engagement. In response to the mainstreaming of environmentalism, Westminster took tentative steps towards establishing an institutional basis for action of sustainable development, emphasising the need for policy coordination while avoiding substantial commitments [84]. Local authorities were placed rhetorically at the front line of sustainable development and expected to develop 'local agenda 21' strategies in consultation with the public. Compounding these developments, national reforms were demanding local authorities to take on a proactive 'enabling' role in the form local partnerships, that were also expected to address the faltering and dissolution of the regional government. Under John Major's Conservative Government, funds from the national government were allocated on the basis of 'capacity for delivery', and local authorities were framed as '*competitive authorities*' [81]. In this national context, Bristol was initially ill-positioned due to political reticence and opposition to public–private partnerships [83]. Under these pressures, a new settlement began to emerge, with the BCC assuming a proactive role, leading to city-wide attempts for coordination and the eventual consolidation of the alternative milieu.

The BCC was primarily involved in self-governing and enabling modes of governing measures, consistent with the 'municipal voluntarism' prevalent among local governments in this period [68]. The council established a 'corporate approach' to sustainable development, seeking to consolidate pre-existing activities of its different departments, fostering new community-led engagement, and attempting to define action plans in the various domains of sustainable development [35,85]. The Green Charter (1990) was an early instance of such corporate approach [86]. A public dialogue led to the identification of potential areas for council action, which were compiled in a public document (Figure 3a). Campaigning groups reacted critically: 'this should have been the chance to set the national agenda for greening local Councils. Instead, the politicians will only adopt those 'green' policies which won't cost them any money or cause them any problems' [78]. Nevertheless, BCC began consolidating internal capabilities while assisted by local environmental groups. In 1991, for example, the council published Bristol Energy and Environmental Plan, developed by UCAT (briefly renamed Bristol Energy Centre), highlighting opportunities for reducing the city's energy demand [87]. Subsequently, it established an Energy Management Unit (EMU), responsible for awareness raising and promoting energy efficiency in the Council's buildings. The EMU reinvested the savings it achieved to remain self-funded. Besides the EMU, a multi-disciplinary Sustainable City team (1994) was established for convening and coordinating sustainability-related activities from different departments and develop a strategic direction. This team also intermediated between the city's environmental groups and BCC. Officers in these units were active in trans-municipal networks such as Eurocities and Energy Cities, and European efforts for connecting experts in sustainable development, which also involved the city's two universities, which reflected a Europeanisation and internationalisation of sustainable development activities [88]. Together, these developments allowed the council to amass expertise and

to identify new opportunities for municipal action in sustainability, learning from cities where other modes of governing were prevalent.



(**a**) (**b**) (**c**)

Figure 3. (**a**) Cover of Bristol Green Charter [86]; (**b**) Create Centre brochure [89]; (**c**) Bristol Energy and Environmental Trust envisioned organisational structure [87].

This led to a change in the pattern of experimentation, as the council became more proactive in shaping the alternative milieu, and a growing number of municipal initiatives that enrolled grassroots groups. This included a number of energy saving and energy awareness initiatives led by the local government, new spaces for demonstrating eco-technologies, and an emphasis on developing collaborative structures. At this point, the groups providing recycling activities were in need of space to expand their activities and managed to lobby the local government to refurbish a warehouse on the outskirts of the city [35]. This led to the development of the CREATE centre (Figure 3b) that housed the Sustainable City Team and various groups established in the previous decade. It was managed by a trust (Figure 3c), which administered the CREATE centre, managed an 'investment unit', and ran a festival for awareness raising. An EcoHome was also built on the site, to act as a visitor s centre, testbed and showroom for various technologies associated with sustainable housing and energy efficiency. The CREATE aimed at replicating the buzz that was found in Colston Street in the previous decade. This kind of activity created new interfaces between the council, grassroots groups and social enterprises, facilitating the 'percolation between the associative and community dynamics and the mobilisation of the municipal teams' [88] (p. 216).

Nevertheless, local collaboration was still limited because of a turbulent funding landscape. For grassroots organisations, funding was increasingly project-based, with contractual relationships, instead of core funding [80]. This demanded greater professionalisation in the management of their activities. Groups in Bristol benefited from the support of intermediary organisations that worked on behalf of civil society at large (e.g., volunteering networks), which provided training and consultancy, and helped them to establish issue-based social enterprises. These were 'run by middle-class professionals who were delivering the social economy on behalf of local people' [36]. The ensuing professionalism improved chances of success for new ventures and increased the visibility of the alternative milieu nationally. It also generated continuous recruitment of members of a 'green middle class' [36]. In the coming decades, Bristol saw the rise of a large contingent of social entrepreneurs. To sustain their funding and increase their impact, these social-enterprises were expanding into regional and national 'markets'. Early groups specialised in various domains of the environmental movement and began acting as knowledge brokers and intermediaries with a national reach [35], which in turn constrained the possibilities for local collaborations.

> (. . .) (for) those main organisations—SUSTRANS, Soil Association, ourselves, Resource Futures, nationally significant organisations, sectoral, theme-based organisations—there hasn't been a place where we have all been getting together (. . .). The effort required to bring us all together, compared to the value we each got out of it (. . .) never quite added up. (. . .) the next best thing to do for each of those organisations were to do more of their own thing, rather than work out how, on a local all, and integration with the wider communier links. (Interview with Simon Roberts)

Despite the difficulties fomenting local collaborations, the reputation and connectivity of the alternative milieu engendered a self-reinforcing dynamic. Attracted by Bristol's vibrant 'green' hub, various private and public organisations began to locate their headquarters in the city. The participation of energy and environmental services in the local economy increased. In the mid-1990s, the city welcomed the headquarters of Triodos, a Dutch ethical bank; Wind Prospect, a wind power consultancy; Solarsense, a developer of solar installations; and the UK's Environmental Agency, then one of the largest environmental protection agencies in the world [84]. This influx diversified the career opportunities that could be found in the milieu. Hence, the city could attract and retain like-minded individuals, who were also drawn to other features of the city, such as its bohemian and alternative outlook, music scene (in this period, Bristol was the cradle of trip-hop and drum-and-bass and an early hotspot of street art), good universities, natural surroundings and relative prosperity [35]: 'Lots of those things come together, and the fact that it has a highly-educated group, that tends to attract other people who like being with people like that (. . .) it starts to fuel its own fire' [Interview with Simon Roberts]. This influx further diversified the alternative milieu, which harboured people from various walks of life. Volunteer, social entrepreneur, activist, professional and political identities overlapped.

> Everyone in the third sector believes that they lead, and the council follows. And I am sure that there are people in politics that think the other way around. And the reality it is iterative and self-reinforcing. I think there is a bigger, wider, organic thing about the city attracting, both growing home-grown talent (. . .) and then attracting (green-minded individuals), that would go work for the voluntary sector, business and council. There is no difference, *people in that movement get jobs in all sectors*. (Interview with Marc Leach, our emphasis)

As in the previous settlement, experimentation with alternatives co-existed and complemented the combative environmental activism and the critical engagement with matters of national policy. In the energy domain, CSE continued to support new groups in the city and to gather expertise in energy advice and energy efficiency. Direct action and opposition to large-scale infrastructure continued, but often in opposition to Westminster. BFOE and the Bristol office of Greenpeace, for example, were involved throughout the 1990s in protests against the expansion of nuclear power, and most major protest cycles in the UK [35]. The interplay between these groups and the council were increasingly important in the alternative milieu.

> (. . .) we need a voluntary sector, a green pioneer movement, that can clear the way. The council cannot be the most radical organisation in the city, obviously, that would be crazy. So, of course, there are (. . .) thought leaders, but equally the council has pioneered and has been at times ahead of the rest of the city. So, it is often far more complex picture than this sexy narrative (. . .) I think that all sectors have led in different ways at different times. (Interview with Marc Leach)

4.3. Third Settlement

By the late 1990s, a new settlement emerged from the accommodation of sweeping local-government reforms and further institutionalisation of the sustainable development agenda. In Bristol, this period brought a new stance of the local government, which contributed to the emergence of the energy scene. National and international developments continued to mainstream

climate action reinforcing the local coordination. Like other European cities at that time, the stance of the BCC became overtly political, further integrating responses to climate change to other municipal agendas, in a trend towards 'strategic urbanism' [90]. Consensus over the urgency of climate change and pressure from the local environmental groups led the council to start guiding its strategy with greenhouse gas budgets and renewable energy targets, which shifted the municipal strategies towards a logic of carbon control [90]. This happened early in Bristol, as the council commissioned its first emission inventory in the year 2000.

Once more, the changes in multi-level governance arrangements opened up opportunities for local government action, changing the modes of governing deployed. With the election of Tony Blair in 1997, local governance in the UK was once more shaken up, as New Labour embarked on a 'local government modernisation agenda' c.f. [91], underpinned by a commitment to a 'third-way' politics between the 'old welfare state' and the neoliberal lean state. This returned some strategic control over service provision to local governments, albeit with a redefined role: the local government was to exert informal influence, convening, coordinating, and acting as 'chief networker' in facilitating service improvements through local strategic partnerships [92]. One such partnership was established in Bristol, building on the Local Agenda 21 (LA21), and helped embed climate change in the local political agenda.

> (. . .) (there was) a kind of organic growth and movement where (. . .) the local strategic partnership, the community strategy, the local agenda 21, that came from Rio, they provided a bit of structure and form and gave quite a specific role to the council. That in effect created a meeting point and a purpose for people to come together around. And I think that created a bit of glue, oiled the conversations, and also provided a bit of structure. (Interview with Simon Roberts)

The resulting Community Strategy Vision included the aims of achieving carbon neutrality by 2050, establishing a municipally-owned energy services company and investing in renewable energy capacity. That document expressed an 'extrospective' stance that aimed to position Bristol as the 'green capital in Europe' [93]. To substantiate this vision, the Bristol Green Capital Partnership (BGCP) was created in 2007 to deliver on the ambitions of the community strategy [94]. The BGCP began congregating other institutional actors interested in sustainability and articulating the bids to the European Green Capital Award from 2008 onwards. These ambitions emerged in the favourable civic climate with a long history of cross-party engagement within the alternative milieu:

> (. . .) That history goes back a long time . . . all political parties have been supporters; there is no massive political difference. And I think some of that political leadership was not necessarily a response [to the environmental movement], but it was maybe enabled, maybe it was made easier because there wouldn't be the backlash (. . .). Politicians can only lead they cannot go. It is like an elastic cord (. . .). They can't lead beyond that or that cord will break, and they will be out of office. (Interview with Mark Leach)

In this settlement, the BCC's approach for controlling carbon emissions was moving beyond self-governing measures, to explore options for governing by provision. The EMU had demonstrated the potential returns of investment on energy activities, but the city was still a laggard when comparing its renewable energy capacity to other counties in the Southwest region [95]. Aiming to expand its scope to encompass city-wide energy use and carbon emissions, the council contracted CSE to conduct comprehensive assessments of the city's carbon footprint and renewable energy potential.

In this period, a new pattern of experimentation emerged, which comprised both council-led initiatives to develop renewable energy projects, and grassroots initiatives were emphasising competing framings of sustainability. The Transition Bristol that began meeting in 2007 emerged as a new forum for grassroots activities [96]. At a time of record high oil prices, transition activists were mobilising around the idea of peak oil. They convened a broad debate in the city which led the

council to publish a response, supported by the BGCP, which reframed the discussion to put more emphasis on promoting a transition away from fossil fuels [97]. A similar process was happening at the neighbourhood level. The transition towns movement promoted an eco-localism approach aiming at self-reliance, local collaboration and conviviality, similar to the DIY ethos of the 1970s. This spurred further experimentation, which included the emergence of a local currency (Bristol Pound) and the establishment of Bristol Green Doors, a project for demonstrating green retrofits. Initiatives that were once symbolic of a countercultural movement were now attracting praise and support from mainstream institutions.

As a result, in the late 2000s, a distinctive energy 'scene' began coalescing with a sharp increase in the number of groups working on energy-related matters, aligning with the emergence of community energy initiatives in other parts of the UK. New feed-in tariffs and sharp drops in the costs of solar were affecting the viability of renewable energy generation for grassroots initiatives, prompting experimentation with new community-led models around the UK [98]. In Bristol, new initiatives could draw support from the BCC, CSE and the wider alternative milieu. In a nationally funded project, the council commissioned CSE to survey the community energy groups in the city, receiving responses from 18 such groups. CSE also administered the Bristol Community Energy Catalyst, a seed fund that helped establish the Bristol Energy Cooperative and other community groups [99]. Meanwhile, the milieu hosted various '(...) supportive local organisations (that) provide inspiration, moral support and common platforms through which ideas could be formulated, shared and developed' [100]. In this context, experimentation included distinct business models and approaches for community-led renewable energy installations, energy efficiency and energy advice. Multiple neighbourhood level groups and two energy cooperatives were founded. The Bristol Power Coop sought to develop 'solar streets', organising the installation of solar panels on rooftops of entire residential streets. The Bristol Energy Cooperative, in contrast, sought to develop solar installations on community and public buildings. Amid this diversity, the Bristol Energy Network (BEN) began meeting in Autumn 2010, 'in response to a flourishing of grassroots activity and the perceived benefits of closer collaboration' [101]. CSE opted to partner with the BEN without leading it, maintaining its volunteer-led character (interview with Bridget Newbery). Despite the BCC's intentions, CSE expertise, and the milieu, the support available to these initiatives was still piecemeal and makeshift.

4.4. Fourth Settlement

The 2010s, saw a new settlement emerge as the council developed further modes of governing and adopted a more experimental and extrospective stance, while community energy initiatives began professionalising and scaling up. This settlement generated new tensions. An ambiguous relationship between the council and community energy groups emerged: on the one hand, there was increasing support for the grassroots initiatives and BEN, and on the other, the council was pursuing its own municipalist strategy, focused on the direct provision of energy services carried out by well-funded teams in the BCC. This settlement resulted in the consolidation of the Bristol energy scene, a shift in the style of leadership as the city achieved a new level of support from European institutions and elected a new mayor.

Another wave of changes in multilevel governance arrangements allowed BCC to deploy new modes of governing climate change in the city. This was given strength with a new mayoral system established in 2012, which contributed to clarifying the leadership profile of the city [102]. George Ferguson, a prominent architect, was elected as mayor. He had a long history of engagement in the city prior to being elected. He was part of the early protests against road construction, acted as a local councillor in the 1970s and was responsible for many iconic projects in the city. He ran for election as an independent and went on to form a 'rainbow' coalition with other parties. Early on, Ferguson began promoting an overly experimental attitude: 'I'm saying Bristol is a laboratory for change (...) We are a testbed: come and try it and help me change it' (George Ferguson quoted in [39]). 'Laboratory

for change' became the tagline of the winning bid for the European Green Capital Award for the year 2015. As George Ferguson's vision for Bristol stated:

> 'Green' is not just about reducing emissions, energy consumption and fending off climate change. Green is a massive economic opportunity. Bristol will position itself, as China embarks on the construction of over 100 brand new cities the size of Bristol, as an exemplar model for self-sustaining and green cities the world over. The opportunities are nearly endless for us to trade on the Green Capital label.
>
> ([103] p.41)

In the early 2010s, BCC had begun amassing further capacities and resources to develop a long-term investment portfolio and experimenting at a city-wide scale, leveraging on the expertise and activities that had build-up in the city. In 2011, internal changes led to the creation of Bristol Futures, bringing together the Sustainable City Team, International Team and Digital Strategies, reflecting the pre-eminence of low-carbon and digital technologies in the city economic strategy. Meanwhile, BCC formed an Energy Services Team, with a wider remit than the EMU. This team began the preparation for setting up a municipal energy company, strengthening the links with community energy groups, and launching successful bids to larger European grants. One such grant, ELENA, allowed the Energy Services Team to establish an investment portfolio and leverage further investment. Previously, the council's initiatives had often been cash-strapped and limited to project-specific grants; now, the council had the means to develop a long-term investment strategy. Together, these developments allowed the intensification of experimentation with city-wide interventions, led by the council. In few years, the council began planning new initiatives in virtually every domain of sustainable energy c.f. [104,105].

Concomitantly, the Energy Scene began to consolidate in this period. The scene now harboured a variety of organisations and activities including: many neighbourhood and place-based community groups developing small-scale schemes for energy efficiency or renewable energy; city-wide energy cooperatives developing renewable energy projects; the council-owned projects operated by the Energy Services Team; BEN operating as an umbrella organisation and CSE acting as an intermediary [99,106]. The scene grew despite rapidly changing policy contexts. However, this rapid expansion reinforced the sense of fragmentation, duplication of efforts, and competition between groups seeking similar support:

> We don't just have one, or try it, we kind of like build on it as well, so it is this rich tapestry of grassroots projects of all sorts. It is a place where lots happen . . . sometimes too many, to the detriment of funding, and competition. And duplication. I remember arguing why are there two energy and power coops? They need two lots of legal (teams), two lots of accountants, two lots of committees. It's a bit odd really. (Interview Martin Fodor)

In effect, these groups went on to propose a Community Strategy for Energy [107], later endorsed by the Mayor. This strategy helped highlight the potential to develop complementarities between the grassroots and the council, and between groups operating at different scales, which is also acknowledged by city officials:

> (. . .) the generation side, generally works in a citywide or slightly larger scale. Because even if that is a local community centre, often the (energy) coops there might be putting solar panels on that. However, the energy efficiency side, (. . .) and that sort of peer-led bottom-up grassroots energy efficiency side, I think that works best at the neighbourhood level. (Interview Mark Leach)

> And they need to work in conjunction with one another (. . .) we are running a matchmaking service, between large business and community energy groups, so basically finding a home for solar PV. That is a citywide initiative, but then we've got the grants filtering through the community groups. (Interview Lorna Edwards)

Some of the grassroots groups benefited directly from such complementarities. The Bristol Energy Cooperative, for example, became a key partner in developing solar power in council buildings (Interview Peter Thompson). However, whereas previously BCC acted mostly as an enabler, this new settlement saw an inclination towards the direct provision of services, even in cases where the grassroots groups were already present. In 2015, the council founded Bristol Energy, a municipally owned supply company. The initiative was backed by the various political parties in the city, in a period when budget cuts forced the local government to find new sources of revenue. The decision was also informed by the council officers' longstanding contacts with European cities with municipal companies and a growing concern with energy poverty in the city. The BCC's leadership was keenly aware of the possibilities offered by such companies, and the extent to which this could catalyse innovative ways of tackling energy poverty, reduce greenhouse gas emissions and drive investment into the city. However, given the limited experience in the UK with municipal supply companies, the project was fraught with commercial risk. Bristol Energy would have to compete against large utility companies and new suppliers, including with OVO Energy and Good Energy, two companies with strong links to the Bristol Energy Scene. As a result, the process for setting up Bristol Energy and defining its strategy was perceived by many community groups to be secretive.

> (The BCC) clearly recognise the importance of the community (. . .) (but this is) not the kind of open engagement that the CSE encourages in our approach to energy management. (. . .) we strongly endorse full consultation, very open and at very early stages (. . .) Whereas it seems that quite a lot has been already decided, and their tiny bits that are given away, but it doesn't give them much space for the community to get involved. (Interview Bridget Newbery)

Thus, in this settlement, the BCC has at times been perceived by community groups as being too assertive, characterising a form of 'self-righteous municipalism' (anonymous interviewee). While at times the grassroots are taken as sources of inspiration, there is also the perception that they are 'pushed aside, ignored or side-lined by an official initiative' (Interview Martin Fodor).

> There will be people who say things happen at the grassroots despite the council, sometimes they happen thanks to the council, and sometimes they happen, and they get taken over by the council, and then some of us might want to put them back in where they belong in the neighbourhoods. (Interview Martin Fodor)

Nevertheless, the co-existence, complementarity and competition between council initiatives, community-led initiates and social enterprises, generates a dynamic that reinforces expectations and forces deliberation over the framing of energy and climate strategy in the city.

> And the grassroots energy initiatives, legitimise, strengthen, reinforce, and stimulate the fact that the council is expected to be doing more, should be doing more, must be doing more, will find ways to do more. And it's not for the community to say 'you shouldn't have set up an energy company', but they will say 'we want there to be local energy, we expect there to be local energy, of course, there should be a local energy company'. (Interview Martin Fodor)

Despite the council's new-found ambitions, the long history of the alternative milieu and the recent consolidation of the energy scene, the hope for joined-up governance remains unrealised. Having departed from its countercultural beginnings informed by radical strands of the environmental movement, the alternative milieu and its energy scene have come a long way. Its objectives are, for now, entangled with new concerns, as evident in the opening words of one of the council's recent energy policy documents [105].

> Through further consultation and development in early 2016 it will develop into a more comprehensive plan which takes into account the action being taken across the city by a wide range of stakeholders. This will help ensure that future policy making in the area is

truly 'joined-up'—avoiding duplication, capitalising on synergies and increasing investor confidence in Bristol as a global leader in city-scale action on climate change.

5. Discussion

5.1. Place-Based Perspective on Niche Formation

Considering the perspective of the local–global model, the case of Bristol would probably be understood as an instance of a broader phenomenon, its experiments representing stages in a multi-locality sequence of experiments, contributing lessons towards an emerging sociotechnical trajectory with the potential to transform the UK's energy system. That perspective is valid if the intent is to understand national-level transitions but has shortcomings in understanding how that particular environment for experimentation evolved.

Taking seriously the observation that experimentation reflects the character of a place, and may reinforce that character, we believe that place-based accounts of niche formation are central for understanding urban transitions. With our approach, we are calling for a distinctive point of view that complements the systemic perspective. This demands attention to the multiplicity of urban experimental processes, place-specificity and multi-scalar relationships. Taking a place-based approach means considering how processes occurring at multiple scales and temporalities matter to a particular place, as our case-narrative illustrates. This requires specific analytical tools to unpack how the context is reconfigured in the long run. Here, it would be fruitful to establish a dialogue between studies attempting to identify contextual success factors (e.g., [32,34]) and place-based accounts of how these factors are enacted.

Despite a growing interest in place-specific styles of experimentation, the existing literature still lacks a consistent way of characterising the patterns of experimentation and how they evolve. Analysing the actors involved, framings and complementarities, competition and coexistence between urban experimental processes [4] was a useful first step. However, in contexts encompassing a large number of such processes, it is hard to interpret these iterations. Developing a method for characterising or mapping these patterns should facilitate comparative and longitudinal studies (see also [108,109]).

5.2. How Bristol Became a Favourable Environment for Experimentation with Civic Energy Alternatives

The approach undertaken was useful in developing an understanding of how the long-term contextual reconfiguration of the alternative milieu developed an active protective space for experimentation with civic energy alternatives, which we labelled Bristol Energy Scene. Throughout this journey, sociotechnical experimentation was taking place, but after unpacking the different settlements, patterns of experimentation and modes of governing (Table 2), we argue that the developments in the context did not conform to the conventional explanation of the niche formation-expressed local–global model in important ways.

Table 2. Summary of the evolution of the environment for experimentation in Bristol.

Settlement	Pattern of Experimentation	Mode of Governing	Outcomes of Contextual Reconfiguration
1st—1970s—1990	Co-existing small-scale socio-technical experiments by grassroots groups with a DIY approach Complementarities in the clustering around Colston street	Enabling: tentative steps in collaboration between local government and grassroots	Vibrant grassroots activism and emergence of the alternative milieu
2nd—1990s	Social enterprises with co-existing experiments with new forms of service provision, and self-governing initiatives to reduce BCC's corporate emissions. Complementary governance experiments around sustainable development, local agenda 21 and the CREATE centre	Enabling: attempts at convening city-wide discussions about sustainable development in local agenda 21 Self-governing: measures of to reduce the BCC's energy consumption	Municipal voluntarism and consolidation of the alternative milieu
3rd—c.a. 1997—c.a. 2010	Competing conceptual experimentation (peak oil, transition town, carbon control) Co-existing governance experimentation with citywide partnerships Competing attempts to develop community energy initiatives forming nascent energy scene	Enabling: BBC asserts its community leadership role, convening processes that embed climate change into council strategy, with an emphasis on carbon control and positioning the city as a green capital Provision: first steps towards governing by provision, assessing potential for generation and developing council-owned wind turbines, and establishing an Energy Service Company	Strategic Urbanism and emergence of the energy scene
4th—2010s	Competing city-wide experimentation aiming at large-scale deployment, with an emphasis on improving business models and funding schemes to deploy mature technologies at scale Complementary experimentation at the neighbourhood level and for the establishing new grassroots initiatives. BCC attempted to develop a municipal energy utility that can potentially exploit the synergies between different kinds of community energy groups	Leveraging: BCC adopts an assertive and extrospective stance, developing an investment portfolio, municipal energy company, and enlisting the energy scene to position Bristol as a global green leader Provision: BCC establishes a municipal energy company and seeks to expand its generation capacity	Municipal (self-)righteousness and consolidation of the energy scene

First, Bristol's energy scene stemmed from reconfigurations of the alternative milieu. Since the first settlement, the anchoring of various initiatives associated with the widespread countercultural movement had begun forming a mesh of individuals, organisations and experimental processes established an institutional base in the city that influences the performance of projects embedded in it and helped enshrine sustainability in the local political agenda [35–38,100]. Early on, the milieu had a DIY character, but it consolidated with increasing professionalisation, experiments targeted at coordination, and concrete efforts by the local authority to support and coordinate the milieu. This enabled the generation, aggregation and retention of knowledge in the local context, building a knowledge base that included tacit knowledge gathered from multiple sociotechnical experiments, conceptual experimentation with various understandings of sustainability, and critical knowledge about the structural impediments obstructing the development of alternatives. This knowledge was sourced from local, national and international activities, but the milieu made it easy to share and retain lessons, as well as making them relevant to local concerns. Because grassroots innovations and civically minded activities could draw from this knowledge base and tap into the resources offered by intermediaries, this milieu influenced positively the performance of individual projects and increased the chances of success or survival [31]. The ensuing agglomeration of initiatives was further reinforced by the inward-migration and attraction that was exerted by this well-renowned alternative milieu, as claims of cultural alterity helped in attracting and retaining countercultural and social-entrepreneurial initiatives, and the milieu helped in sustaining alternative life-styles and ideologies [31].

This alternative milieu, however, was not static so tracing its evolution was a crucial challenge in our analysis [30]. Scrutiny reveals a variety of understandings about sustainability that informed developments in the city. These understandings were often synchronous with developments taking place at other scales, including early experimentation informed by the alternative technology movement, local agenda 21 initiatives, the transition towns movement, and discourses around peak oil which were salient in particular periods. It was only recently that constituents of this scene began articulating a shared vision for a low-carbon, decentralised energy transition in the city, but even then, multiple ideas of how to achieve this vision still co-existed. We identified distinct settlements that emerged to accommodate shifts in multi-level governance arrangements, which had implications in terms of the degree of autonomy and resourcefulness of the local government. The period from the 1970s to 2015 covers drastic changes in the governance arrangements imposed on UK cities. It is not surprising that developments in Bristol were affected, and that the passage between settlements was coupled with governance changes initiated from Westminster, given how little discretion has traditionally been afforded to English local authorities [81,92]. However, rather than a linear process of imposing new changes from above, the case study demonstrates that it accommodating or resisting these developments at the local level were also crucial. Local actors changed and reframed their activities proactively as a way of adapting to challenging institutional contexts and in order to take advantage of new structures. During the second settlement, the pattern of experimentation changed considerably, as the alternative milieu consolidated through various efforts to enable and coordinate sustainability-related activities in the city. In the third and fourth settlements, the energy scene emerged from this milieu, as a result of the institutionalisation of climate change in the local political agenda, and the direct engagement of the Bristol city council in initiating its own experiments alongside the development of community energy in Bristol and elsewhere in the UK. In each settlement, experimentation was driven by multiple framings of sustainability, which meant a constant shifting between different approaches and agendas. Hence, the formation of this scene is best understood as emerging through a process of discontinuous contextual reconfiguration, involving multiple urban experimental processes and an array of networks that attempted to provide support to new initiatives, increase their chances of success, and facilitate collaboration (e.g., LA21, BGCP, BEN).

Second, the formation of the Bristol energy scene differs from the internal processes of niche formation: it emerged from localised path-dependencies associated with the development of the alternative milieu, constituting 'incidental protection'. Incidental is defined by the Oxford dictionary as 'happening as a minor accompaniment to something else' and 'occurring by change in connection with something else' [110]. Incidental protection results from the co-location of parallel activities, as complementarities can be found in the local pool of expertise, spill overs from previous experiments, and resources that are available in the milieu. It occurs often by chance, as actors embedded in the milieu are immersed in the local buzz that is generated; activists, social entrepreneurs, city officials and (green-minded) politicians mingle in the same social circles, frequent meetings, seminars, and shared spaces (e.g., Colston Street, CREATE centre, Hamilton House). This incidental protection emerged organically over a long period and was reinforced by the co-existence of radical countercultural spaces, skilful intermediaries mediating between various interests, and organisations seeking viable business models and operating at other scales. This form of protection is crucial for the longevity and renewal of the alternative milieu. Incidental protection differs from the active or passive forms of shielding [16] which depend on the development of a broader institutional field that alters the selective environment and from activities associated with nourishing, it is not the outcome of purposive efforts to nourish experiments, because it is a fortuitous benefit that actors embedded in the milieu can reap by being there.

What explains the persistence of the alternative milieu in Bristol, considering that various places in the UK and elsewhere experienced the rise in environmental counter cultures and alternative milieus in the 1960s and 1970s without necessarily developing contemporary experimental settings? The importance of the grassroots initiatives should not be overstated. As referred by a government

official, there is a risk of unduly corroborating a 'sexy narrative' which attributes the greenness and radicalness of Bristol entirely to its alternative milieu. According to our analysis, this persistence derives from three place-specific, path-dependant developments:

- The emergence of multiple nationally significant professionally run environmental charities (e.g., CSE, SUSTRANS), which have their origins in the early days of the alternative milieu, and which became capable intermediaries.
- A continual reproduction of urban experimental processes within the milieu and the energy scene, which acted as sites of both contestation and collaboration, not simply increasing the performance and suitability of technologies to a particular context but instead 'culturing' plural alternatives [111] and fostering the necessary conditions for their flourishing.
- The close relationship that developed between local government activities and the milieu, made possible by the 'percolation' between these activities [88] and the acquisition of new capacities and prerogatives by the local government. This is observable in the increased participation of local government in initiating urban experimental processes, and the evolving modes of governing deployed by the local government (Table 2).

From the second settlement onwards, officers of the local government acting on the interface with grassroots activities were important to support, maintain and potentiate activities in the alternative milieu, providing an enabling role that helped consolidate the milieu. Since then, the rationales and priorities of the alternative milieu have been 'percolating' into the local government [88]. In the fourth settlement, however, BCC assumed a more proactive and assertive role, beyond enabling existing activities, diverging from the national trend. It expanded its activities, amassed new capacities, and created a dedicated team covering every mode of governing (Table 3), and managed to diversify project funding over time with a large portfolio of activities receiving support. This was attained by leveraging the knowledge, resources and reputation accumulated in the alternative milieu and energy scene. Particularly in the last two settlements, the BCC successfully *leveraged* the local activities to position the city as a leader in sustainability and municipal energy developments. This is evident in how the vibrancy of the city's alternative milieu and energy scene is a centrepiece of the city's participation bids for international awards (e.g., European Green Capital), membership and leadership in elite trans-municipal networks (e.g., 100 Resilient Cities, C40 Climate Leadership Group, Covenant of Mayors), participation in large-scale European research projects (e.g., 7th Framework Projects, Horizon 2020), and competition over funding from national and international agencies (e.g., European Investment Bank). This strategy proved successful in a context of intercity competition over resources, where cities' accomplishments in terms of sustainability and carbon control can potentiate new investments that supposedly alleviate some of the worst effects of austerity, or help the local authority respond to the imperative of generating local economic development. However, it is also fraught with difficulties, as it involves reframing existing activities and redirecting efforts towards internationally oriented green growth strategies, which stands in sharp contrast with eco-localism rationales that inform many of the grassroots experiments found in the alternative milieu.

We argue that leveraging can be understood as a fifth mode of governing, that is salient as local authorities become increasingly proactive in an environment of inter-city competition. This mode consists of *leveraging* as local authorities promote and curate city reputations based on past achievements and successful (grassroots) experiments. This is done in order to mobilise new resources, secure participation in exclusive networks of knowledge exchange (e.g., trans-municipal networks, large-scale research projects), and access new opportunities for investments, resources and opportunities for knowledge exchange (e.g., trans-municipal networks). This mode of governing is reminiscent of 'policy boosterism' [112]: in a macro-context of intense inter-city competition, portraying the city as a green-entrepreneurial exemplar is intertwined with leveraging urban sustainability to attract investments and people. City-branding is central to leveraging, as local authorities rework the image and reputation of their cities, placing emphasis on their 'greenness', 'innovativeness' or

alternative characters. As seen in the last settlement, promoting the city as a laboratory, is a powerful new way of exerting leveraging. Future research should engage further with exploring the political consequences of these strategies.

Table 3. Modes of governing associated with the different teams of the local authority.

Team	Year of Establishment	Modes of Governing Employed
Energy Management Unit	1994	Self-governing—handling the council's own emissions and energy consumption. Folded into the Energy Services team in 2001
Sustainable City Team	1994	Enabling and leveraging, but applied to sustainability more generally
Energy Services Team	2011	Enabling and self-governing, provision and leveraging of energy related activities, including council housing, investment in renewable energy installations, support to community energy projects, city-wide energy infrastructure development
Bristol Energy	2015	Provision: operating as an energy supply company since its creation in 2015

6. Conclusions

In this study, we developed a place-based approach to research the formation of a favourable environment for experimentation. Starting with the SNM's conceptualisation of the formation of protective spaces for innovation, we realised the need to consider the multiplicity of urban experimentation, the treatment of place-specificity and the coexistence of local and trans-local relationships.

To redress these issues, we conceptualise niche formation as occurring through a process of contextual reconfiguration, whereby socio-technical experiments, modes of governing and conceptions of sustainability are assembled, reconfiguring the urban context in a process that could culminate on urban transitions [4]. To examine that process in detail, we analysed different settlements, patterns of experimentation and modes of governing. Our approach complements the systemic perspective of most transition studies and is compatible with spatialised accounts of the formation of niches in multiple localities [20,21]. We argue that this approach has wider applicability for studies focusing on urban experimental spaces, the nature of how such experimental spaces emerge, and why distinctive styles of experimentation develop in some places but not others.

Through an in-depth examination of how the Bristol energy scene emerged, we emphasised the relational and contingent nature of place, in which local, national and international developments were intertwined. The alternative milieu and the energy scene are not simply a background, colourful but static, to the activities in the city.

Our account emphasised the co-evolution between urban experimentation and governance and highlighted how various actors mobilised a multiplicity of technologies, concepts and ways of governing to pursue different pathways for reconfiguring the local energy system. The meshing of these activities formed a localised concentration of organisations, practices and institutions which helped to create the cultural, material and institutional conditions for a diverse and ever-changing set of countercultural lifestyles, political identities and practical efforts to realise sustainability. Beyond the scope of our approach, other facets of the context in Bristol are likely to have influenced the emergence of energy as a matter of concern, such as the material fabric of the city (e.g., prevalence of poorly-insulated terraced houses) and wider institutional context (e.g., council ownership of social housing), for which more targeted studies might be necessary.

This milieu afforded protection to other urban experimental processes analogous to the concept of a niche as conceived by SNM. It was also a space of encounters, where community-led projects meet municipally-led investment portfolios, and where activist groups encounter professionally run social enterprises. The energy scene is the outcome of a long-term reconfiguration of this milieu, mediated by established environmental organisations, the collaboration and competition between activities,

and the engagement of the local authority. It is because of this history that it has been oriented towards civic framings of what an energy transition could be. We found no evidence of the constituents of the energy scene rallying behind a single sociotechnical trajectory; instead, those actors were attempting to mobilise elements from different trajectories to develop locally relevant solutions.

Through our case study, we identified two salient processes that influence the formation of niches in an urban context. First, the distinction between passive and active shielding that is commonly accepted in the SNM perspective obscures a third form of protection. We labelled this *incidental protection*, given that it happens as a result of co-existing activities and chance encounters by actors embedded in the milieu. This form of protection is likely to be of relevance in other cities which have an alternative milieu, or in places with strong agglomerations of entrepreneurial activity, but hard to replicate elsewhere. Second, we also learned that the local authority has developed over time a sophisticated apparatus to access various modes of governance, and most recently, the ability to do *governing by leveraging*. This mode is likely to be widespread because local authorities have been facing a heightened inter-city competition in the allocation of funds and policies. We invite other researchers to join us in investigating the political consequences of enlisting experimental environments that emerge organically to meet particular agendas.

To advance urban transitions research, we should move beyond assuming cities behave neatly as protective spaces. Cities are not undisputed launch pads for experimentation. Therefore, we call for further exploration of alternative avenues for niche formation that attend to the politics of urban transitions. It would be fruitful to complement case studies tracing a single socio-technological trajectory with cases zooming in to capture the evolution of the urban context and taking a place-based perspective. Gathering insights regarding the historical evolution of favourable environments for experimentation and synthesising them into workable heuristics should inform strategies to mobilise experimentation in favour of urban transitions. Here, we believe that typologies and taxonomies of experimentation need to be complemented with an understanding of the 'genealogy' of experimental spaces, and comparative studies of such genealogies (c.f. [108,109]). Future work should pay due attention to the antecedents of these spaces, discern path-dependencies and place-specificities and move past static notions, such as success factors, to interrogate the dynamics and chains of events that engender different kinds of experimentation in different places. Efforts in this direction should embrace the generative potential of other dynamics beyond protection. Developing these nuanced accounts could identify the foundations on which to build effective experimental governance in particular places or inform attempts to develop place-based niches that tackle urban transitions.

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Abbreviations

BCC	Bristol City Council
BEN	Bristol Energy Network
BFOE	Bristol Friends of the Earth
BGCP	Bristol Green Capital Partnership
CAT	Centre for Alternative Technology

CSE	Centre for Sustainable Energy (Formerly UCAT)
DIY	Do-it-yourself
ELENA	European Local Energy Assistance, a grant from the European Investment Bank
EMU	Energy Management Unit, a team within the BCC
LA21	Local Agenda 21
MLP	Multi-level Perspective
SNM	Strategic Niche Management
UCAT	Urban Centre for Alternative Technology

Appendix A. Interviewees

All but one of interviewees agreed to be named in the research.

Anonymous	Community energy practitioner and researcher
Bridget Newbery	Community Project Manager, CSE; Volunteers, BEN
Caroline Bird	Research Fellow, University of Bristol; Chair BEN
David Saunders	Founder, Bristol Power Co-op
Lorna Edwards	Former Community Energy Project Manager, BCC, Energy Services Team
Lorraine Hudson	Smart Cities and Sustainability Consultant; Former Climate Change Co-ordinator
Mark Leach	Project Manager BCC, Sustainable City Team; Former Green Capital Coordinator
Martin Fodor	Councillor, BCC; Former Sustainable City Policy Co-ordinator
Peter Thompson	Chair, Bristol Energy Co-operative
Simon Roberts	Chief Executive, CSE; Board Member BEN.

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